

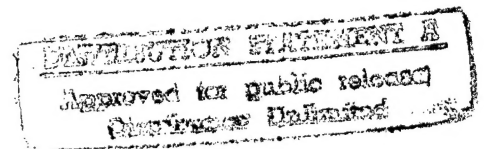
ENERGY ENGINEERING ANALYSIS

FORT DEVENS
SENECA ARMY DEPOT
LETTERKENNY ARMY DEPOT

CONTRACT NO. DACA65-80-C-0003

VOLUME 1
EXECUTIVE SUMMARY

FORT DEVENS
MASSACHUSETTS



Original February 1982
Revised September 1983
Revised November 1985
Revised May 1986

Reynolds, Smith and Hills
Architects-Engineers-Planners,
Incorporated

FINAL SUBMITTAL

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DEPARTMENT OF THE ARMY
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INTRODUCTION

Original 2/82
Revised 9/83
Revised 11/85
Revised 5/86

In February 1980, the Norfolk District Corps of Engineers initiated Contract No. DACA65-80-C-0003 with Reynolds, Smith and Hills of Jacksonville, Florida. This contract called for the performance of Energy Engineering Analysis Programs of three U.S. Army installations: Fort Devens, Massachusetts; Letterkenny Army Depot, Pennsylvania; and Seneca Army Depot, New York. The objective of these Programs was the identification, evaluation, and development of programming documents for energy conservation projects which meet the criteria of the Army's Energy Conservation Investment Program (ECIP):

At Fort Devens (Devens) the initial work under this contract called for the following studies:

1. Increment A - Energy Conservation Investigations for Buildings and Processes
2. Increment B - Energy Conservation Investigations for Utilities and Energy Distribution Systems
3. Increment C (Biomass only) - Investigation of Renewable Energy Projects

Increment A & B were performed in three phases. The first phase consisted of site surveys to inspect the major energy consuming buildings and systems, and collect data required for the identification and evaluation of potential ECIP projects. The detailed evaluation of the potential projects took place in the second phase and the development of the necessary documents in the third phase. Only the first phase, a preliminary assessment of economic feasibility, was authorized for Increment C.

Since the original contract issue, several additional investigations were funded. In May 1981, the contract was expanded to include development of projects identified in Increments A & B that did not qualify under ECIP criteria (Increment G). The original issue of the Executive Summary (February 1982) summarized the above investigations and was included on pages ES-1 through ES-23 of this document.

In September 1982, the contract was extended to include investigation of central boiler plant projects (Increment E). The revised Executive Summary (September 1983) summarizes the results of Increment E starting on page ES-23 this document. In addition, the discussion on fuel consumption and cost (pages ES-2 through ES-14) were updated with current information when available.

In October 1983, and October 1984, the contract was again extended to include energy audits of the Cutler Army Hospital, Vail Dental Clinic and Oral Health Center and Increment F, Facility Engineer Conservation Measures.

BASELINE DATA

1. Description of the Installation

Fort Devens is located approximately 40 miles west of Boston, Massachusetts in the vicinity of the town of Ayer. Fort Devens is a Forces Command installation (FORSCOM Headquarters is Fort McPherson, Georgia) with a four-fold mission: maintain combat readiness in its assigned units; support Army Reserve, National Guard and R.O.T.C. units in the Northwest; support various contingency plans; and represent the Army in New England. The installation contains about 9,416 acres. Table 1, taken from the Fort Devens Facilities Energy Plan, is a breakdown of the land use.

Population estimates place the installation's resident population at 11,330 and non-resident, 5,888. There are 715 permanent buildings containing over 5,246,687 square feet of floor space, and 444 temporary buildings with close to 2,342,941 square feet. Fort Devens is the only Army base in New England and provides support to many other active Army Reserve units in the region.

The scope of the Energy Engineering Analysis Program for Fort Devens was limited to the major buildings, excluding the hospital, or groups of buildings located in the Cantonment Area.

2. Energy Consumption

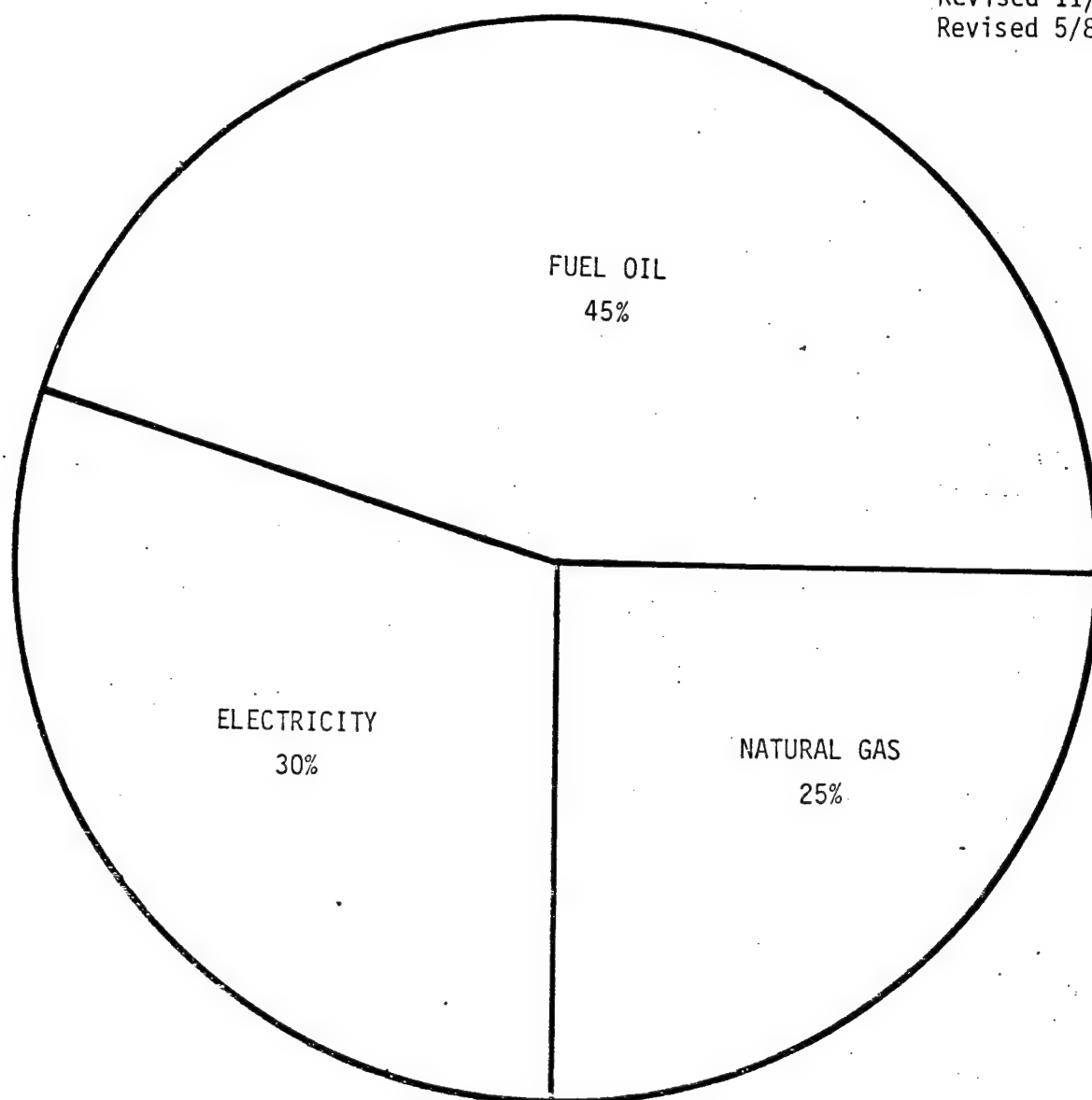
Primary energy sources for building use at Fort Devens are electricity, natural gas and fuel oil. The major building energy requirements at Fort Devens is space heating, which is supplied by either natural gas or fuel oil. In FY 79 fuel oil accounted for 45% of the total building energy use and natural gas accounted for 25% (See Figure 1). In FY 85 those percentages changed to 38 and 24% for fuel oil and natural gas, respectively (Figure 1a).

Over the period of 1975 through 1979, the consumption of electricity at Fort Devens was virtually unchanged, while the consumption of fuel oil and natural gas changed considerably (See Figure 2). Since 1979 fuel oil use has continued to drop, while natural gas has remained relatively constant. Electricity use has increased markedly since FY 79, approximately 45% by FY 82. The FY 85 figures, however, show about a 25% drop from the FY 82 value. This yields about a 20% increase since FY 75.

TABLE 1
 LAND USE AT FORT DEVENS, MASSACHUSETTS
 1978 - 1982

	<u>Acres</u>
A. <u>The Cantonment Area</u>	
--Troop Housing-Cantonment Area - Developed and Improved Grounds	770
--Family Housing	938
--Hospital	259
--Education	15
--Recreation	458
--Warehouse and Shops	412
--Ammo Storage Area	204
--Sanitary Landfill	108
--Buffer Area	83
	<hr/>
SUBTOTAL	3,247
B. <u>The Main Range and Training Area</u>	
--Firing Range and Other Active Areas	2,756
--Wildlife, Timber, Recreation, Agricultural and Greenbelt Areas	2,104
--Other (Including Route 2 Easement)	294
	<hr/>
SUBTOTAL	5,154
C. <u>Northern Range Area and Airfield</u>	
--Airfield	327
--Firing Range and Other Active Areas	341
--Wildlife, Timber, Recreation, Greenbelt	347
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SUBTOTAL	1,015
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TOTAL	9,416

Original 2/82
Revised 9/83
Revised 11/85
Revised 5/86

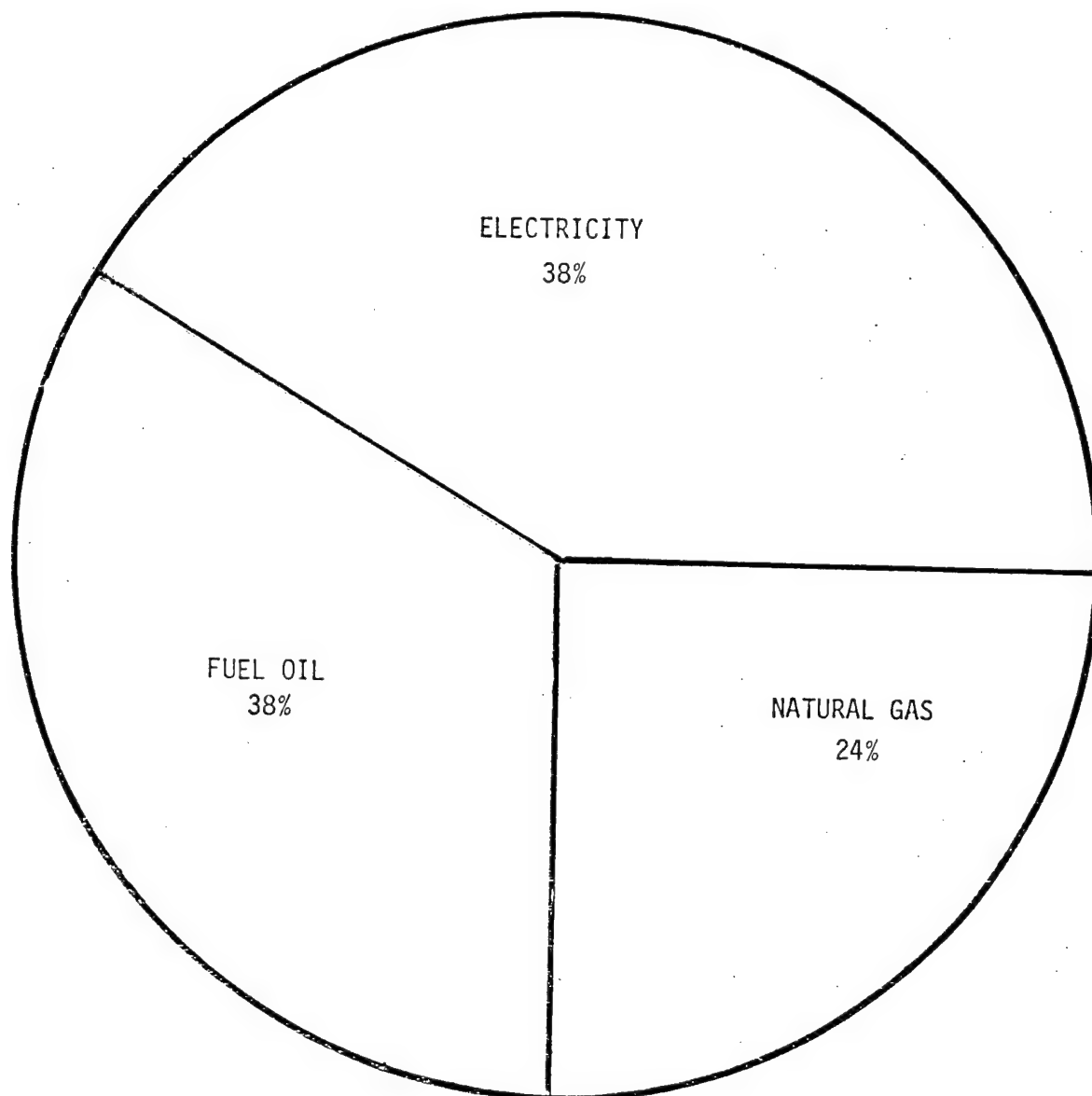


TOTAL ENERGY USE - 1,407 *Billion Btu's

FORT DEVENS
ENERGY USE DISTRIBUTION - FY 79

FIGURE NO. 1

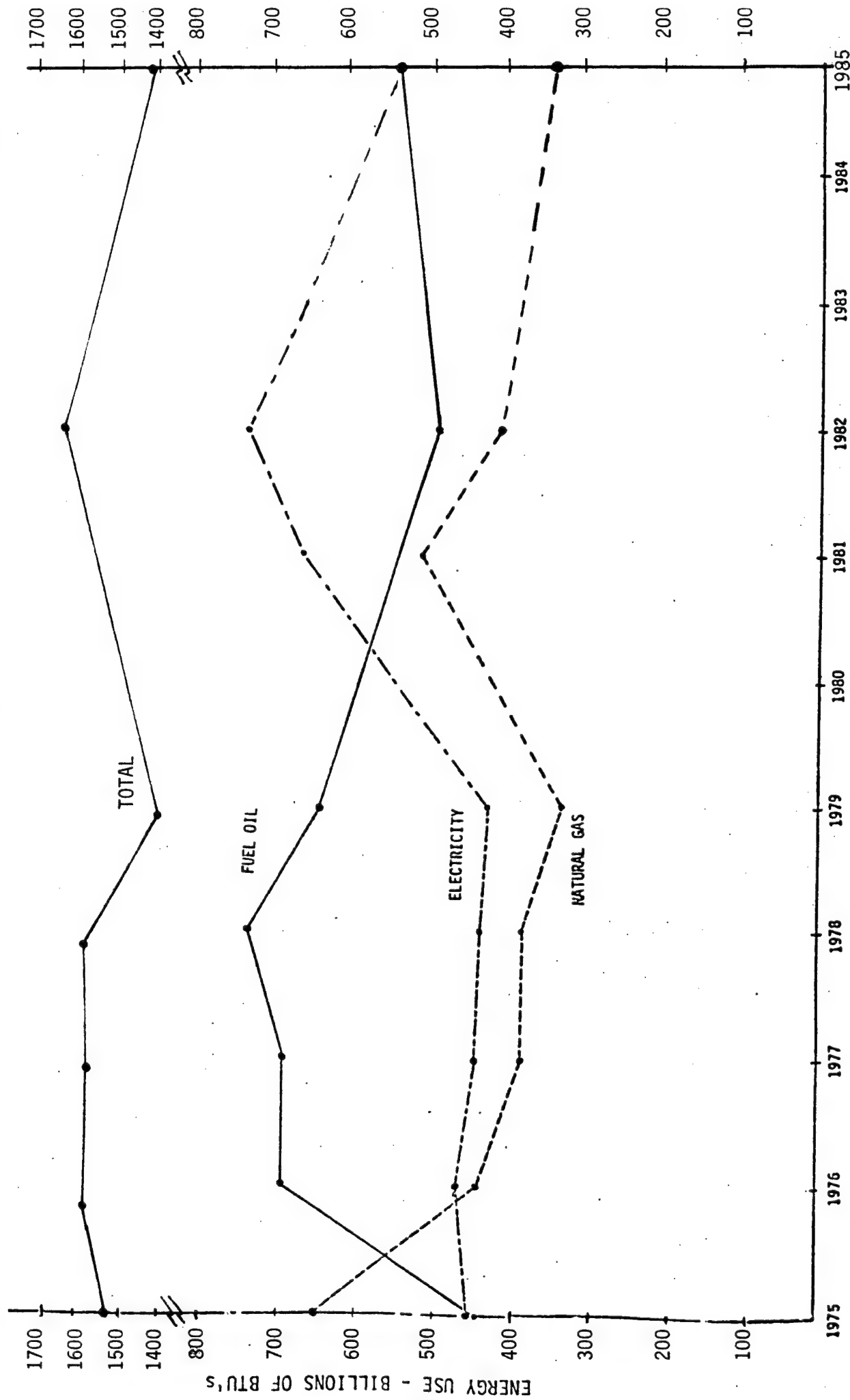
* FY 85 consumption 1409Billion Btu's



TOTAL ENERGY USE - 1409 Billion Btu's

FORT DEVENS
ENERGY USE DISTRIBUTION - FY 85

FIGURE NO. 1a



Original 2/82
 Revised 9/83
 Revised 11/85
 Revised 5/86

FORT DEVENS
TOTAL ENERGY CONSUMPTION

FIGURE NO. 2

A major change in oil and gas consumption occurred in 1976 when many boilers with dual fuel capability were changed from gas to oil as their primary fuel. The combined consumption of the three energy sources changed very little from 1975 to 1985.

The cost of the three energy sources has risen dramatically since 1975. Fort Devens paid 131 percent more for electricity in FY 85 than it did in FY 75, although consumption only rose approximately 20 percent (see Figure 3). Likewise Fort Devens' natural gas bill rose 79 percent from FY 75 to FY 85, even though the consumption was reduced 46 percent during the same period. The total amount spent by Fort Devens for fuel oil rose 126% from FY 75 through FY 85 with an 18% rise in consumption.

2.1 Electricity

Electricity for Fort Devens is supplied by New England Power Company. The Post has a high base electrical consumption comprised primarily of lights, boiler plant auxiliaries, refrigeration equipment and computers. Based on the most recent data available (FY 79) the highest electrical consumption occurs during the winter months, while the highest peak demand occurs in the summer (see Figure 4). The high summer peak is caused by air-conditioning loads superimposed upon the base electrical load.

The cost of electricity supplied to Fort Devens in FY85 is \$0.0390774 per kilowatt hour for energy and fuel adjustment, and \$10.98 per kilowatt for demand. There is no ratchet clause in the rate schedule for Fort Devens.

2.2 Natural Gas

Natural gas for Fort Devens is supplied by the Boston Gas Company. The use of natural gas has been curtailed significantly since 1975 by switching to oil in those boilers that were capable of burning either fuel. At present, the major users of natural gas at

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Revised 5/86

FORT DEVENS
ANNUAL ENERGY COSTS

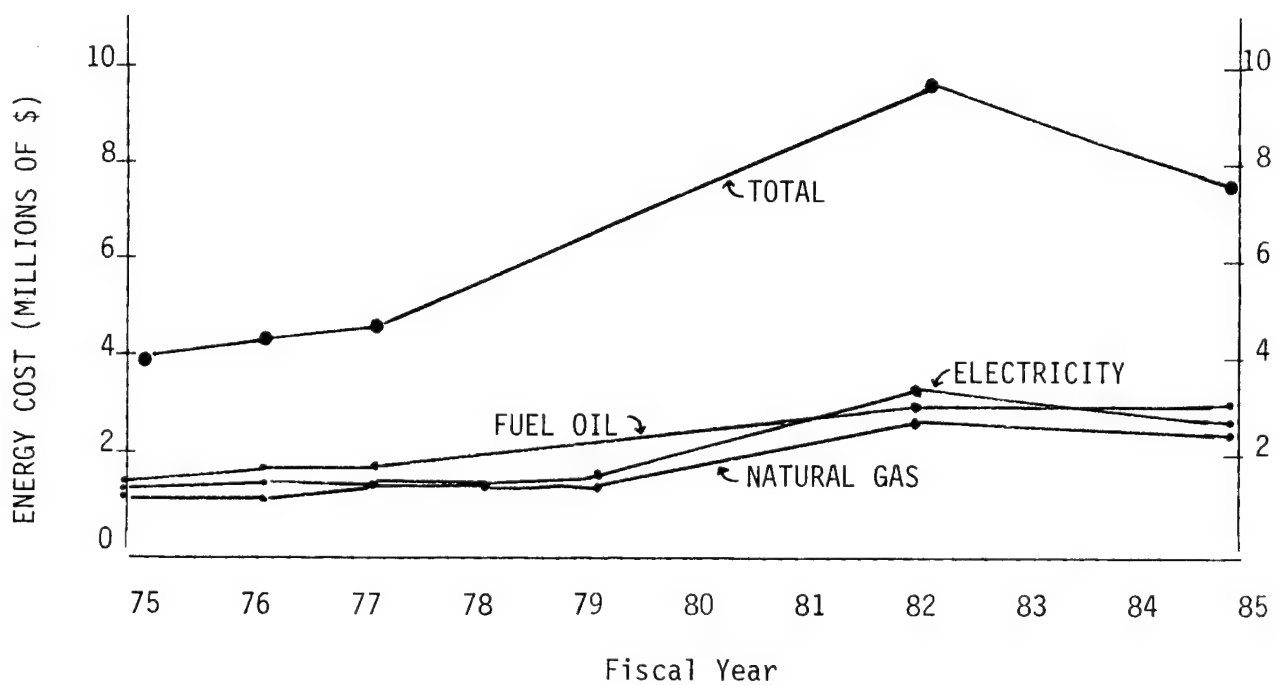
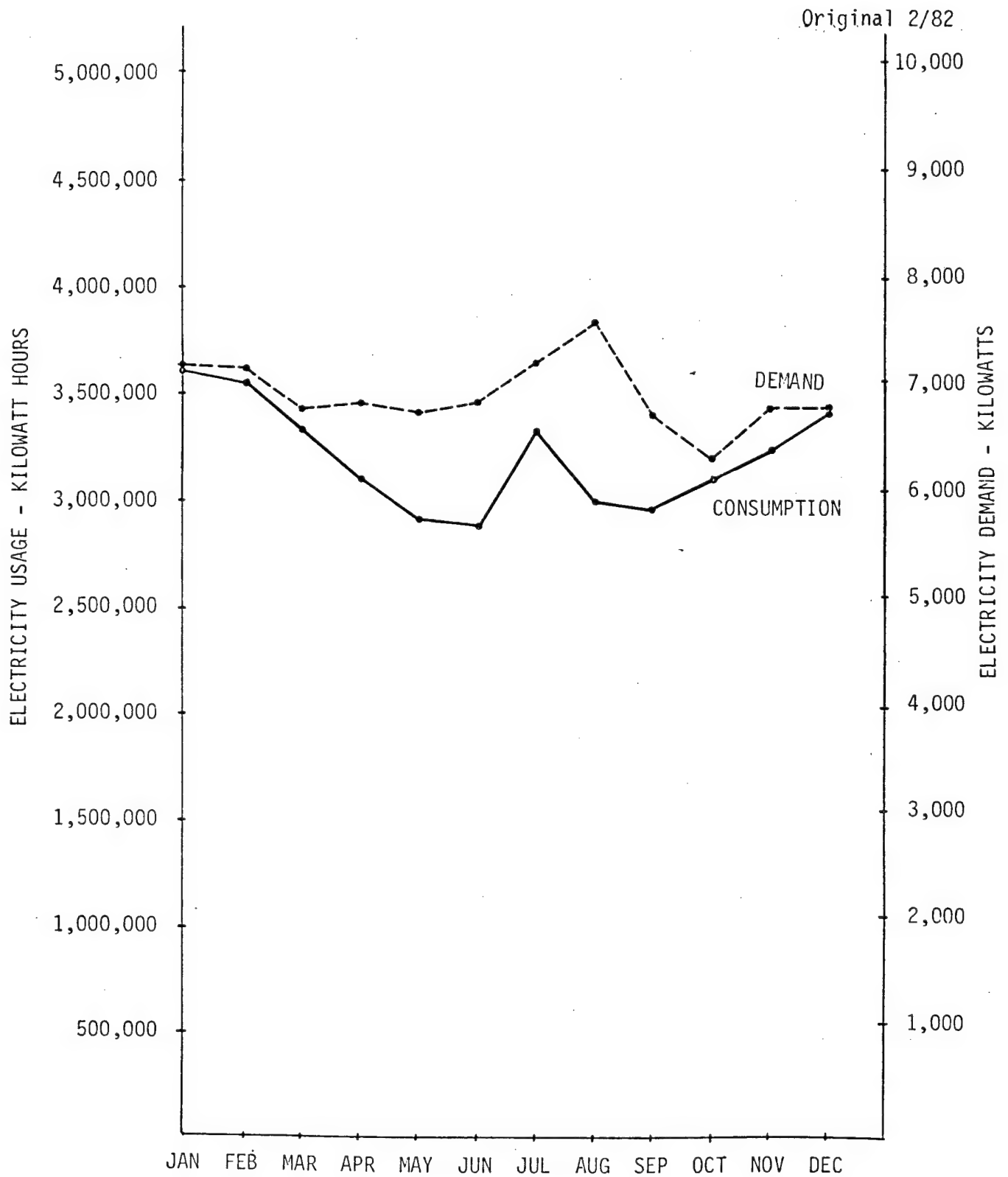


FIGURE NO. 3



FORT DEVENS
TOTAL ELECTRICITY
CONSUMPTION AND DEMAND
(FY 79)

FIGURE NO. 4

Fort Devens are family housing and the temporary buildings. The largest individual user of natural gas is the swimming pool (See Figure 5).

Since natural gas is used primarily for space heating, the consumption drops off rapidly in the warmer months (See Figure 6). The summer consumption is for domestic hot water production in family housing.

The cost of natural gas supplied to Fort Devens in FY 85 is \$.727 per 100 cubic feet (\$7.05 per MBtu).

2.3 Fuel Oil

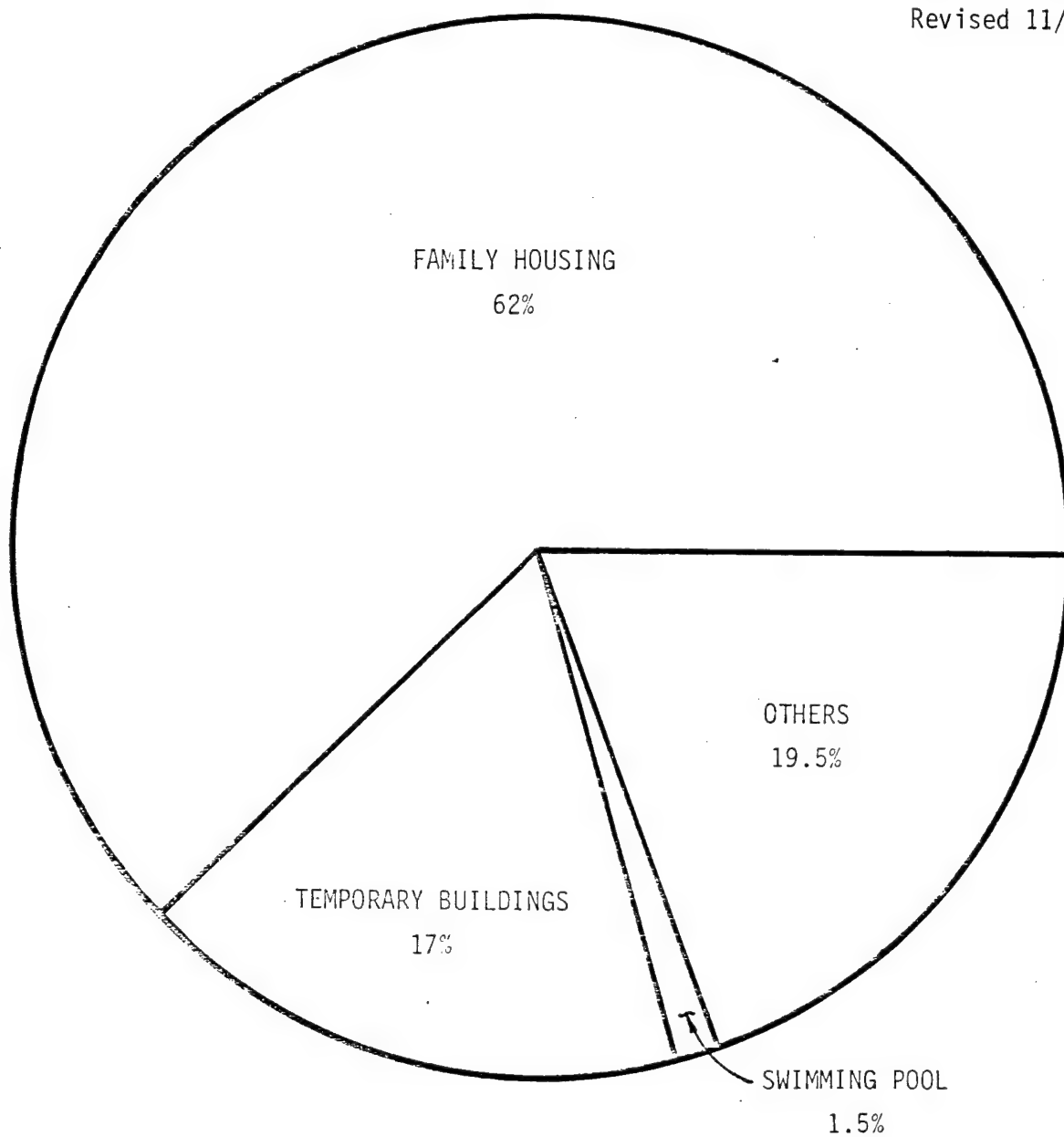
Fuel oil for Fort Devens is supplied by various different contractors. Both No. 2 fuel oil and No. 4 fuel oil are used. The larger central heating plants use No. 4, while No. 2 is used primarily by heating plants serving individual buildings.

The major users of fuel oil at Fort Devens are the barracks and temporary buildings. The hospital is the largest individual user of fuel oil followed by the field maintenance shop, Building No. 3713 (See Figure 7). The use of fuel oil in family housing is limited to the Wherry Housing area which is served by central heating plants.

When the fuel oil and natural gas usage is combined, the heaviest consumption is concentrated in three areas: family housing, barracks, and temporary buildings (See Figure 8). The combined consumption of these three groups of buildings is 57.1 percent of the total fuel oil and natural gas consumption at Fort Devens.

The cost of fuel oil supplied to Fort Devens in FY 85 is \$1.03 per gallon for No. 2 fuel oil (\$7.43 per MBtu) and \$0.80 per gallon for No. 4 fuel oil (\$5.56 per MBtu).

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Revised 11/85

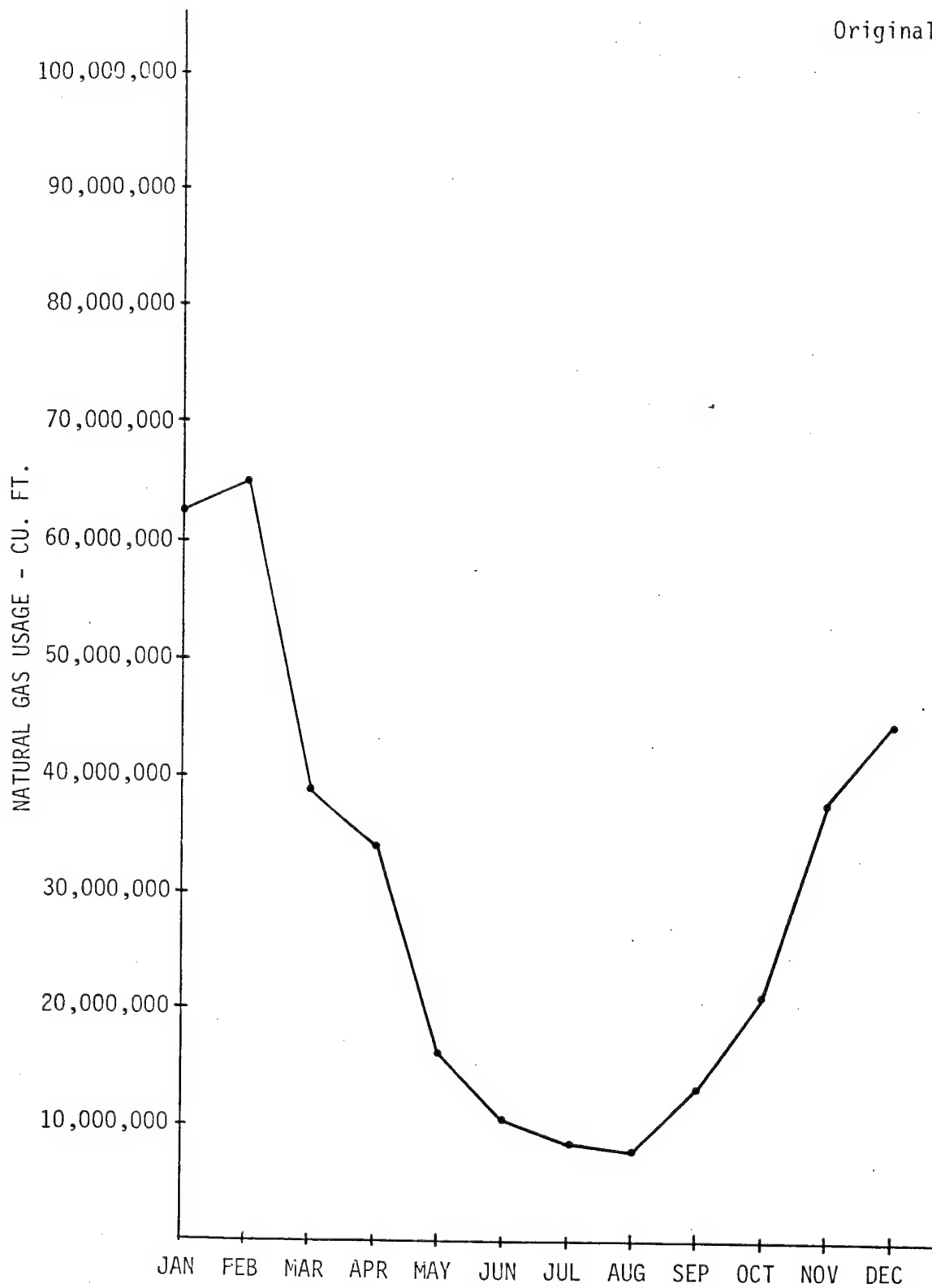


TOTAL NATURAL GAS USE - 375,722*MBtu

FORT DEVENS
NATURAL GAS USE DISTRIBUTION - FY 79

FIGURE NO. 5

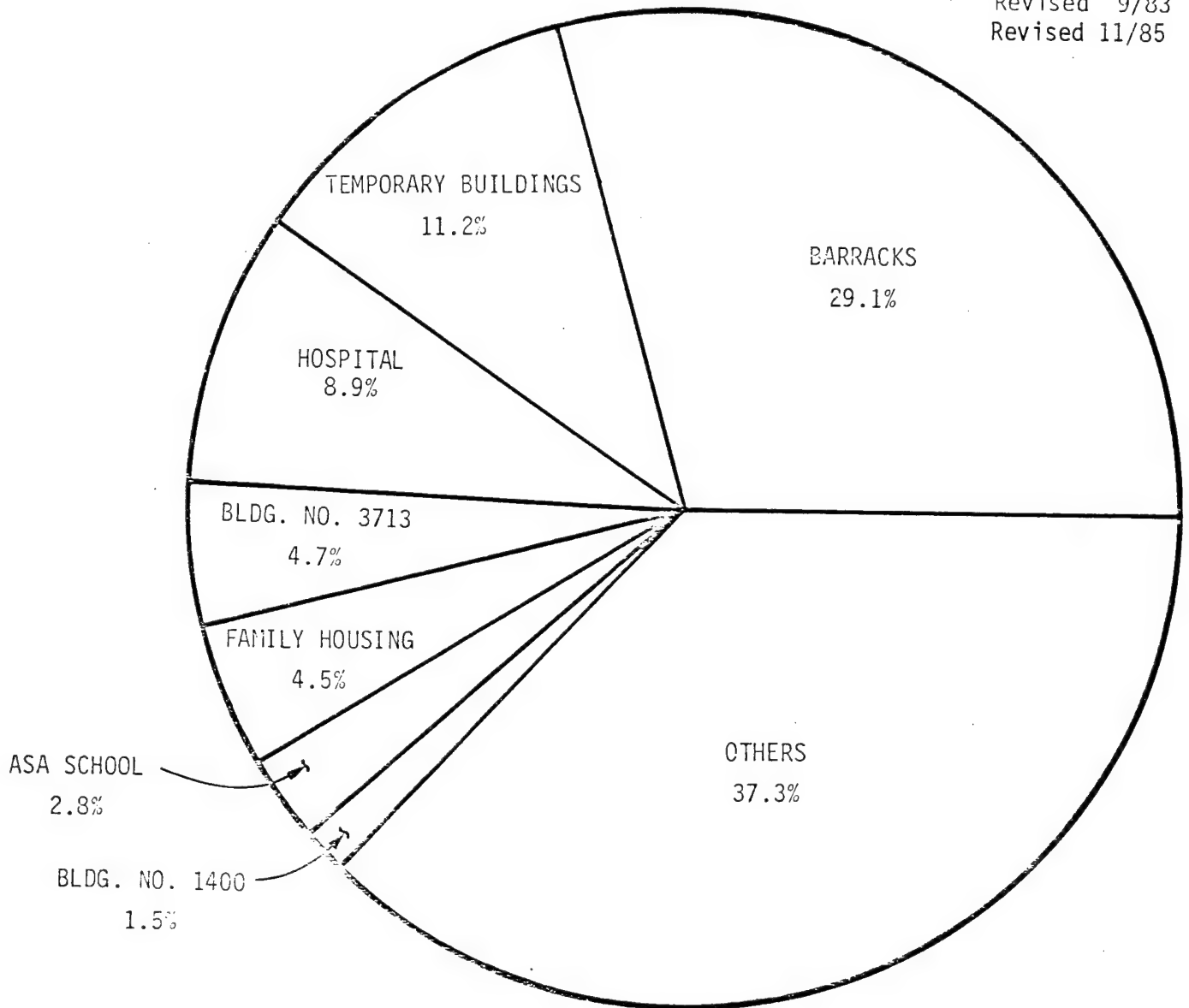
* FY 85 consumption 345,307



FORT DEVENS
TOTAL NATURAL GAS CONSUMPTION
(FY 79)

FIGURE NO. 6

Original 2/82
Revised 9/83
Revised 11/85



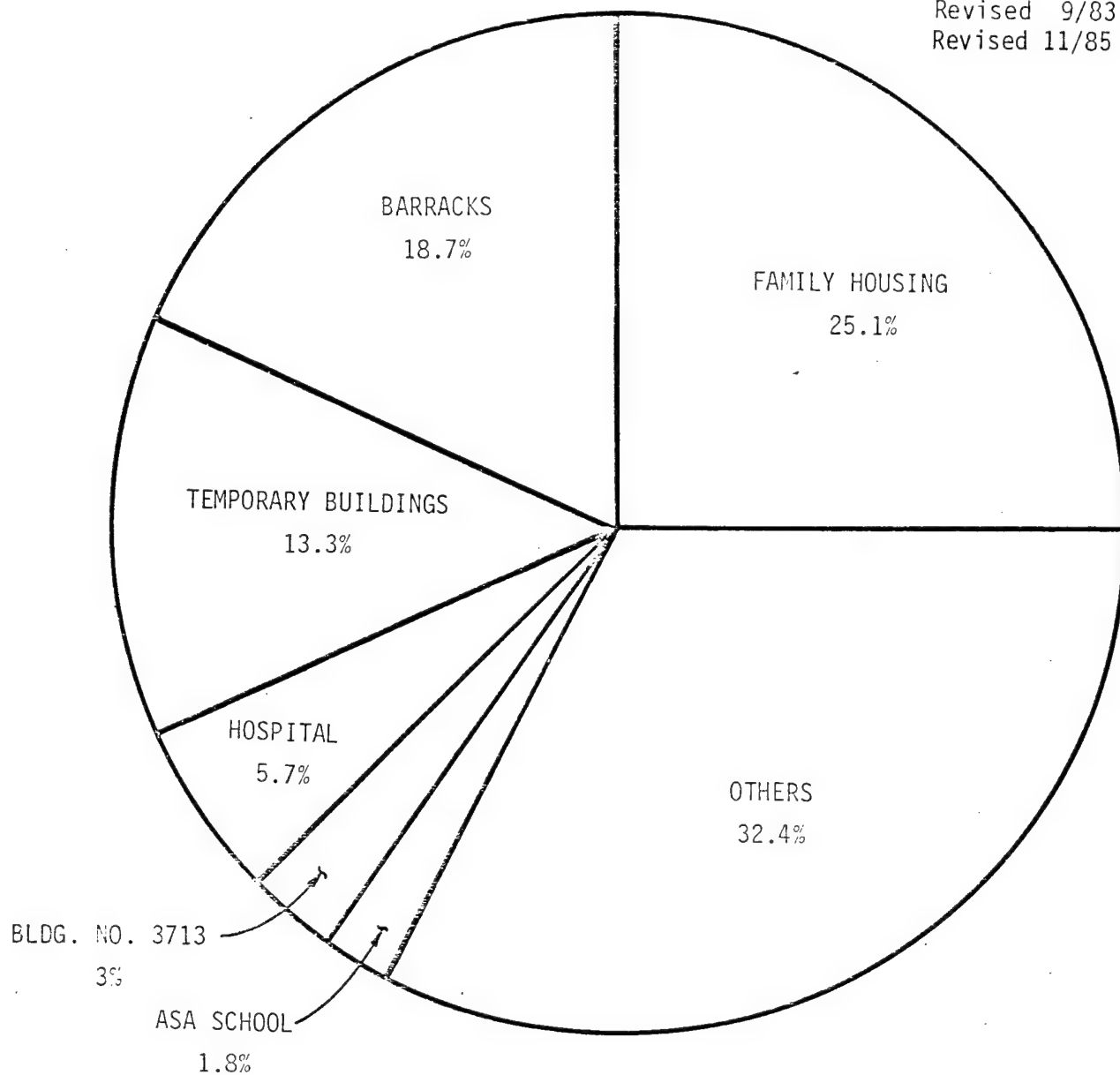
TOTAL FUEL OIL USE - 678,042* MBtu

FORT DEVENS
FUEL OIL USE DISTRIBUTION - FY 79

FIGURE NO. 7

* FY 85 consumption 532,301

Original 2/82
Revised 9/83
Revised 11/85



TOTAL FUEL OIL & NATURAL GAS USE - 1,053,764*MBtu

FORT DEVENS
FUEL OIL AND NATURAL GAS
USE DISTRIBUTION - FY 79

FIGURE NO. 8

* FY 85 consumption 877,608

2.4 Conclusions

The energy consumption data for Fort Devens clearly indicates that the prime areas for ECIP projects to reduce the consumption of oil and natural gas are family housing, the barracks, and temporary buildings. These three areas account for over 57 percent of the consumption of these fuels and at FY 85 fuel prices account for over \$4,500,000 a year in fuel costs. Likewise, the duplication of building types within each of these areas presents the ideal conditions for efficient utilization of project analysis time, since the results of one analysis can be applied to numerous similar or identical buildings. These three areas were therefore given maximum consideration in the identification and analysis of potential ECIP projects.

STUDY RESULTS

1. Field Surveys

Field surveys were conducted of the major buildings or groups of buildings included in the scope of work. The purpose of these surveys was to obtain data relative to the buildings' construction, occupancy, functional use, energy consumption, completed or programmed energy conservation or other modifications, and energy consuming equipment and systems. These data were then used to identify candidate ECIP projects and potential operating and maintenance improvements.

Building survey data are summarized in Appendices of prior reports. Observations made during the field surveys are included as well as recommendations for energy savings. Where an ECIP analysis was made on a potential energy saving project, the results of that analysis are indicated. Other indicated recommendations for potential energy savings were considered operating or maintenance measures, or were capital improvement projects which were considered too small for qualification as ECIP projects. In a few cases, potential ECIP projects are identified but were not analyzed either due to unavailable drawings or data, or due to planned modifications to the building which would preclude ECIP analysis at this time.

2. Results for Major Building Types

2.1 Family Housing

With the exception of the Wherry Housing area, which is served by oil-fired central heating plants, all of the family housing units are served by residential type gas furnaces. None of these furnaces are equipped with energy saving features such as electronic ignition, vent dampers, or additional insulation. The addition of these features to the existing units was evaluated as was the complete

replacement of all the furnaces with new, energy efficient models. The complete replacement has been recommended at a cost of \$1,582,946 with an estimated net annual energy savings of 22,082 MBtu. The simple amortization period is 7.2 years, with B/C ratio of 2.3 and E/C ratio of 14.0 (project A/B-L).

The hot water for these same family housing units is supplied by gas-fired hot water heaters. These units also are not equipped with energy saving features. The installation of electronic ignition devices and vent dampers on these units was evaluated as an ECIP project and although it qualifies, it is not recommended because the payback is longer than the normal expected life of a hot water heater. It is recommended, however, that, as these units are replaced, they be replaced with energy efficient units equipped with extra insulation, electronic ignition and vent dampers. The incremental cost of the energy efficient water heater is easily justified.

The Wherry Housing units were originally constructed without any wall insulation in their wooden frame walls. The installation of blown-in loose-fill insulation in the wall cavities was evaluated and is recommended. The cost of the project is \$288,230 and the estimated annual energy savings is 4,730 MBtu. The simple amortization period is 6.7 years, with B/C ratio of 3.5 and E/C ratio of 16.4 (project A/B-J).

Solar energy for the production of domestic hot water for the Wherry Housing area was evaluated but does not qualify as an ECIP project (A/B-S).

Replacement of incandescent lighting fixtures in the kitchens and bathrooms of the family housing units was evaluated but resulted in an unacceptable E/C ratio and cannot be recommended (project A/B-Q). However, this was recommended under Increment G (G-T).

2.1.1 Energy Savings

The total estimated annual energy savings from the recommended family housing ECIP projects is 4,730 MBtu of fuel oil or 15.2 percent of the present family housing fuel oil consumption, and 22,746 MBtu of natural gas or 9.7 percent of the present family housing natural gas consumption. The electronic ignition of the furnaces will increase the electrical consumption of family housing by 664 MBtu.

2.2 Barracks

Replacement of incandescent corridor lights in the Two-Company EM Barracks with fluorescent fixtures and lights was evaluated and is recommended. The project cost is \$49,965 with an annual energy savings of 2,702 MBtu. The simple amortization period is 1.44 years, with B/C ratio of 8.79 and E/C ratio of 54.1 (project A/B-B). This project does not meet the \$100,000 cost requirement of the ECIP program and will either have to be grouped with other ECIP work or funded from another program.

Heat recovery from the toilet exhaust fans in the Two-Company EM Barracks was evaluated and recommended. The project cost is \$203,925 with an annual energy savings of 8,420 MBtu. The simple amortization period is 2.54 years, with B/C ratio of 9.4 and E/C ratio of 41.3 (project A/B-C).

Heat recovery from the kitchen exhaust fans in the Five-Company Consolidated Mess Halls was evaluated and recommended. The project cost is \$205,835 with an annual energy savings of 7,626 MBtu. The simple amortization period is 2.70 years, with B/C ratio of 8.83 and E/C ratio of 37.0 (project A/B-D).

Modifications to the boilers in Barracks Building Nos. 649, 650, 657, 665, 694 and 696 were evaluated and are recommended. The modifications include replacement of the existing on/off, mechanically atomized burners equipped with modulating controls. The cost of the project is \$827,101 and it will save 11,502 MBtu's of fuel annually. The simple amortization period is 6.88 years, with B/C ratio of 3.23 and E/C ratio of 13.9 (project A/B-G).

In EM Barrack Nos. 637 and 638, which have a high window/wall ratio, blocking up a portion of the window area was evaluated but is not recommended due to an unacceptable E/C ratio (project A/B-N). However, this was recommended under Increment G (project G-J).

Insulation of the walls in EM Barracks Nos. 666, 673, 674, 693, 695, 697, 658, 647, 651, 652 and 655 was evaluated but is not recommended on the basis of an unacceptable E/C ratio (project A/B-P). However, this was recommended under Increment G (project G-MM).

2.2.1 Energy Savings

The total estimated annual energy savings from the recommended barracks ECIP projects is 29,904 MBtu of fuel oil or 15 percent of the present barracks fuel oil consumption and 346 MBtu of electricity.

2.3 Temporary Buildings

There are approximately 261 temporary buildings at Fort Devens of similar construction, i.e., wood frame with wood siding, asphalt shingled roof and crawlspace with skirting. Very few of these have building shell insulation. A project to insulate the walls and ceilings of 194 of these buildings was evaluated. The other 67 buildings were not considered for insulation either because of the satisfactory condition of the building exterior or because they were scheduled for vinyl siding and insulation. The results of the evaluation indicated that 159 of these temporary buildings are good candidates for insulation, and this work is recommended. The total cost of the project is \$2,544,473 and it will save approximately 37,120 MBtu of fuel annually. The simple amortization period is 6.1 years, with B/C ratio of 4.28 and E/C ratio of 14.6 (project A/B-K).

2.3.1 Energy Savings

The recommended temporary building ECIP project will produce annual energy savings of 20,045 MBtu of fuel oil and 17,075 MBtu of natural gas, or 26 percent of the present total temporary building consumption of fuel oil and natural gas.

2.4 Hospital

Although the hospital was excluded from the scope of work of this initial study, the hospital was considered for the installation of a solid waste incinerator with heat recovery because it is the only facility at Fort Devens that has a significant year-round steam demand. It is therefore the only facility at Fort Devens which could utilize all the energy available from the Post's solid waste at all times of the year. The evaluation indicated that the installation at the hospital would qualify as an ECIP project and is recommended. The cost of the project is \$1,685,371 and it will save 28,293 MBtu of energy annually. The simple amortization period is 12.6 years, with B/C ratio of 2.87 and E/C ratio of 16.8 (project A/B-H). The hospital also was considered for the installation of a wood-fired steam generation facility. Results of the preliminary analysis show that proposed facilities cannot be recommended.

Additional energy studies were made on the hospital as part of a modification to the original contract (see p. ES-33).

2.4.1 Energy Savings

The installation of a solid waste incinerator with waste heat recovery to produce steam will reduce the hospital's present annual fuel oil consumption by 52 percent or 31,383 MBtu's. The electrical consumption at the hospital will be increased by 3,090 MBtu or 9% annually due to the installation of the incinerator.

2.5 Building 3713

Building 3713, the Combined Field Maintenance Shops, is a 253,440 square foot heated building with 26-foot high, 14-inch thick brick walls and an insulated flat roof. A project to insulate the walls and portions of the windows was evaluated. It is recommended that this insulation project be implemented using pre-insulated modular industrial-type metal wall panels on the lower wall sections up to the ten-foot level and sprayed-on exposed cellulose insulation applied to the upper section of walls, including window areas above the ten-foot level. The installation will cost \$173,679 and will save 4,300 MBtu annually. The simple amortization period is 4.44 years, with B/C ratio of 5.34 and E/C ratio of 24.8 (project A/B-E).

2.5.1 Energy Savings

The 4,300 MBtu annual fuel savings resulting from the recommended insulation project will reduce the present fuel consumption of Building 3713 by 13.6 percent.

2.6 Lighting

Street lighting and exterior area and parking lot lighting is presently accomplished at Fort Devens using a multiplicity of light types and sizes. Replacement of these lights with various types of high efficiency lighting systems was evaluated. The study determined

that high pressure sodium vapor lighting is the most cost effective and is recommended. The street lighting replacement will cost \$216,014 and save 3,869 MBtu annually. The simple amortization period is 13.7 years, with B/C ratio of 1.34 and E/C ratio of 17.9 (project A/B-F). The area and parking lot lighting will cost \$346,704 and save 4,816 MBtu annually. The simple amortization period is 12.4 years, with B/C ratio of 1.3 and E/C ratio of 13.9 (project A/B-I).

Replacement of the incandescent lighting system in General Warehouse Building 1400 with a high efficiency lighting system was evaluated but not recommended because of an unacceptable E/C value (project A/B-M). However, this project was re-evaluated and recommended under Increment G (project G-I).

2.6.1 Energy Savings

The recommended ECIP lighting projects will reduce the Post's annual electrical consumption by 8,685 MBtu or 1.9 percent of the total annual electrical consumption of the Post.

2.7 Energy Monitoring and Control System

Many of the administrative, service, recreational, and maintenance buildings at Fort Devens represent good candidates for energy monitoring and control since their limited hours of operation provide opportunities for building temperature set-back and reduced ventilation during off hours. Although these buildings represent a small percentage of the total fuel consumption at Fort Devens, substantial energy savings can be achieved from such an installation on buildings with basically a Monday through Friday, 0730 to 1600 occupancy schedule. The installation of an EMCS controlling 27 buildings with a computer-based central system, as preferred by the Facilities Engineer, is recommended in the Increment A/B documents. The installation will cost \$873,923 and save 26,774 MBtu annually (project A/B-A). The simple amortization period is 7.16 years, with B/C ratio of 3.17 and E/C ratio of 30.6. Increment F recommends the expansion of the existing Dimension PBX system. This system currently controls 48 points with a capacity of 200. A project is recommended to control 12 points in 8 buildings. The estimated construction cost is \$19,560 and will save 4557 MBtu annually.

3. INCREMENTS A & B: ECIP's IN BUILDINGS, PROCESSES,
UTILITIES, ENERGY DISTRIBUTION SYSTEMS AND EMCS

There were 23 projects developed under Increments A & B; 12 were recommended for funding. The implementation of the recommended ECIP's will result in the following reductions in the current consumption levels of fuel oil, natural gas and electricity at Fort Devens when completed.

Fuel oil - 16.1 percent reduction
Natural gas - 12.5 percent reduction
Electricity - 1.4 percent reduction

The reduction in fuel oil and natural gas for major buildings or building groups is indicated in Tables 3-1 and 3-2.

The recommended projects represent an investment of \$8,998,166 with an estimated annual savings of 162,234 MBtu and \$1,328,519 (1984\$).

Projects investigated under Increments A, B & G's scope of work are summarized in Tables 3-3 and 3-4. Projects are prioritized by their E/C ratio and grouped into the two categories of qualifying/recommended and non-qualifying/not recommended. Qualified projects (Table 3-3) under Increments A & B are those which have a 1982 E/C > 15, (a 1983 E/C > 14 or a 1984 E/C > 13), have a B/C greater than one and have a construction cost in excess of \$100,000 (1933). Qualifying projects under Increment G are those which have a simple payback less than 15 years and have a B/C greater than one. Non-qualifying projects (Table 3-4) are those which do not meet the standards for qualifying projects. Many of these A/B projects later qualified under Increment G and are contained in Table 3-3. Complete descriptions, calculations and back-up information can be found in the previously completed Increments A/B and G Reports. Each project has a two-part identifier which is composed of the increment designation. For example, A/B-D means Project D studied during Increment A/B.

4. Increment C: Summary of the Preliminary Investigation into a
Wood-Fired Steam Generation Facility

A preliminary investigation was made into the utilization of wood as a fuel to offset some of the fossil fuel used at Fort Devens for steam production. Two major areas were investigated:

- a. Available wood resources in and around Fort Devens.
- b. Economics of different sized wood-fired steam plants at Fort Devens.

The first wood-fired facility examined was one which would burn wood available from post forests only. The other facility examined was one which would supply all of the hospital's steam requirements. The reason the hospital was chosen is that it is the only building at Fort Devens with any appreciable year-round steam requirements, thus maximizing the energy savings potential of the wood-fired facility.

TABLE 3-1
ECIP PROJECT ENERGY SAVINGS SUMMARY
FUEL OIL (FY 79)

<u>FUEL OIL</u>			
<u>Building(s)</u>	<u>Present Consumption (MBtu)</u>	<u>ECIP Savings (MBtu)</u>	<u>Percent Reduction</u>
Family Housing	30,519	4,730	15.5
Temporary Buildings	76,105	20,045	26.3
Barracks	197,169	29,904	15.2
No. 3713	31,680	4,300	13.6
Hospital	60,618	31,383	51.8
No. 1400 (EMCS)	10,794	1,377	12.7
ASA School (EMCS)	19,192	7,696	40.1
Others (EMCS)	<u>251,965</u>	<u>9,674</u>	<u>3.8</u>
Subtotal	678,042	109,109	16.1

TABLE 3-2
ECIP PROJECT ENERGY SAVINGS SUMMARY
NATURAL GAS (FY 79)

<u>Building(s)</u>	<u>Present Consumption (MBtu)</u>	<u>ECIP Savings (MBtu)</u>	<u>Percent Reduction</u>
Family Housing	234,050	22,746	9.7
Temporary Buildings	64,830	17,075	26.3
Swimming Pool (EMCS)	5,855	1,951	33.3
Others (EMCS)	<u>70,987</u>	<u>5,070</u>	<u>7.1</u>
Subtotal	375,722	46,842	12.5

TABLE 3-3
FORT DEVENS
PROJECT SUMMARY
INCREMENTS A, B, & G
FINAL SUBMITTAL

<u>Inc-/Proj.</u> <u>rmt/No.</u>	<u>Description</u>	<u>CWE</u> <u>(FY84\$)</u>	<u>B/C</u>	<u>E/C</u>	<u>Payback</u> <u>Period</u> <u>(Years)</u>	<u>Annual</u> <u>Energy</u> <u>Savings</u> <u>(MBtu)</u>	<u>Annual</u> <u>Dollar</u> <u>Savings</u> <u>(FY84\$)</u>
<u>QUALIFYING PROJECTS - ESCALATED TO FY 84</u>							
A/B-B.	Replacement of Barracks Corridor Lights	49,965	8.79	54.1	1.44	2,702	34,473
A/B-C.	Toilet Exhaust Heat Recovery in Two-Company EM Barracks (666,673,674,693, 695 & 697)	203,925	9.4	41.3	2.54	8,420	80,313
A/B-D.	Exhaust Heat Recovery in Five-Company Consolidated Mess Halls (649, 657, 665, & 696)	205,835	8.83	37.0	2.70	7,626	76,304
G-A.	Insulate Water Heating Equipment-Bldg. 2005	1,578	4.3	36.5	2.2	58	709
A/B-A.	Installation of Energy Monitoring & Control Systems	873,923	3.17	30.6	7.16	26,774	121,971
A/B-E.	Insulation of Walls and Windows in Building No. 3713	173,679	5.34	24.8	4.44	4,300	39,087
G-II.	Building Shell Insulation (Window Replacement) Bldg. Nos. 649,650, 657,665,694, & 696 (Consolidated Mess)	66,040	4.8	22.0	4.9	1,470	13,362
G-B.	Bldg. Shell Insul. (Walls) Bldg Nos. 637 and 638	102,936	4.2	19.3	5.7	1,990	18,089
G-C.	Bldg Shell Insul. (Walls) Bldg Nos. 601-604, 612, 613, 616, and 617	76,147	5.2	17.9	4.5	1,360	16,742
A/B-F.	Street Lighting Modifications	216,014	1.34	17.9	13.7	3,869	15,716

TABLE 3-3 (Cont'd.)

FORT DEVENS
PROJECT SUMMARY
FINAL SUBMITTAL
INCREMENTS A, B, & G
QUALIFYING PROJECTS

Inc- rmt./	Proj. No.	Description	CWE (FY84\$)	B/C	E/C	Payback Period (Years)	Annual Energy Savings (MBtu)	Annual Dollar Savings (FY84\$)
A/B-H.		Heat Recovery Incinerator	1,685,371	2.87	16.8	12.6	28,293	133,556
A/B-J.		Wherry Housing Wall Insulation	288,230	3.5	16.4	6.7	4,730	42,996
A/B-K.		Insulation of Temporary Buildings	2,544,473	4.28	14.6	6.1	37,120	414,289
G-D.		Bldg Shell Insul. (Walls) Bldg 1401	41,031	3.0	14.0	7.8	575	5,227
A/B-L.		Replacement of Natural Gas Furnaces in Family Housing Units	1,582,946	2.3	14.0	7.2	22,082	220,130
G-E.		Bldg Shell Insul. (Walls) Bldg Nos. 1649 and 1650	45,598	4.1	13.9	5.9	632	7,780
A/B-G.		Burner Modifications to Boilers in Bldgs 649,650,657,665,694 and 696	827,101	3.23	13.9	6.88	11,502	120,196
A/B-I.		Area & Parking Lighting Mods.	346,704	1.3	13.9	12.4	4,816	29,488
G-JJ.		Building Shell Insul. (Ceiling) Bldg Nos. 19,20,21 (B. O. Q.)	27,709	3.0	13.7	8.0	379	3,445
G-F.		Bldg Shell Insul. (Ceiling) Bldg No. 2	6,587	3.7	12.9	7.9	85	833
G-G.		Bldg Shell Insul. (Walls) - Bldg No. 692	62,296	2.8	12.8	8.6	795	7,227
G-H.		Bldg Shell Insul. (Walls) Bldg No. 3500	6,354	3.7	12.6	6.4	80	985
G-I.		General Warehouse Lighting Mods. Bldg. No. 1400	145,231	2.8	12.6	5.0	1,823	28,837

TABLE 3-3 (Cont'd.)

FORT DEVENS
PROJECT SUMMARY
FINAL SUBMITTAL
INCREMENTS A, B, & G
QUALIFYING PROJECTS

Inc- rmt/Proj. No.	Description	CWE (FY84\$)	B/C	E/C	Payback Period (Years)	Annual Energy Savings (MBtu)	Annual Dollar Savings (FY84\$)
G-J.	Window Replacement Bldg Nos. 637 & 638	118,911	2.7	12.3	8.9	1,463	13,299
G-K.	Bldg Shell Insul. (Ceiling) Bldg 692 (Included with G-G write-up)	55,060	2.6	12.2	9.0	674	6,127
G-KK.	Insulation of Walls and Roof of General Warehouse-Bldg No. 1400	235,940	2.6	11.9	9.2	2,809	25,534
G-L.	Bldg Shell Insul. (Ceiling) Bldg 219	32,096	3.4	11.4	8.9	366	3,590
G-M.	Bldg Shell Insul. (Ceiling) Bldg No. 227	5,961	3.3	11.2	9.1	67	657
G-N.	Bldg Shell Insul. (Ceiling) Bldg No. 243	27,580	3.2	10.9	9.3	302	2,963
G-O.	Bldg Shell Insul. (Walls) Bldg 2 (Included with G-F write-up)	12,327	3.1	10.5	9.7	130	1,274
G-P.	Bldg Shell Insul. (Ceiling) Bldgs 601-604, 612, 613, 616, & 617 (Included with G-C write-up)	162,579	3.0	10.2	8.0	1,651	20,324
G-Q.	Bldg. Shell Insul. (Ceiling) Bldg. No. 16	34,193	2.2	10.2	10.8	349	3,172
G-LL.	Building Shell Insul. (Ceiling) Bldg No. 25 (Headquarters Annex)	7,293	3.0	10.2	10.0	74	728
G-MM.	Insulation of Walls in Enlisted Barracks, Bldg Nos. 666, 673, 674, 693, 695, 697, 658, 647, 648, 651, 652, & 655	796,957	2.1	9.6	11.4	7,663	69,655

TABLE 3-3 (Cont'd.)

FORT DEVENS
PROJECT SUMMARY
FINAL SUBMITTAL
INCREMENTS A, B, & G
QUALIFYING PROJECTS

Inc- rmt.	Proj. No.	Description	CWE (FY84\$)	B/C	E/C	Payback Period (Years)	Annual Energy Savings (MBtu)	Annual Dollar Savings (FY84\$)
G-NN.		Bldg Shell Insul. (Ceiling)-Bldg No 3712 (Commissary Warehouse)	136,083	2.1	9.6	11.5	1,305	11,862
G-R.		Bldg Shell Insul. (Walls) Bldg No. 1	16,271	2.8	9.4	10.8	153	1,499
G-S.		Bldg Shell Insul. (Walls) Bldg 16 (Included with G-Q write-up)	23,795	2.0	9.2	11.9	220	2,000
G-T.		Kitchen and Bathroom Lighting Renovations	700,093	1.4	9.1	12.4	6,382	56,279
G-00.		Building Shell Insul. (Ceiling)-Bldg No. 17 (REF)	17,070	1.7	7.9	13.9	135	1,227
G-U.		Bldg Shell Insul. (Walls) Bldg 219 (Included with G-L write-up)	23,975	2.3	7.7	13.3	184	1,805
G-V.		Bldg Shell Insul. (Ceiling) Bldg No. 1696	42,713	2.2	7.6	13.5	323	3,169
G-W.		Bldg Shell Insul. (Wall) Bldg 243 (Included with G-N write-up)	28,205	2.2	7.4	13.8	208	2,040
G-X.		Bldg Shell Insul. (Walls)-Bldg 227 (Included with G-M write-up)	18,070	2.2	7.3	14.0	132	1,295
G-Y.		Bldg Shell Insul. (Walls) Bldg 1696 (Included with G-V write-up)	15,067	2.1	7.2	14.2	108	1,059
G-PP.		Bldg Shell Insul. (Walls)-Bldg 1696 (Included with G-V write-up)	37,663	1.9	6.6	12.3	248	3,053

TABLE 3-3 (Cont'd.)

FORT DEVENS
PROJECT SUMMARY
FINAL SUBMITTAL
INCREMENTS A, B, & G
QUALIFYING PROJECTS

Inc- rmt.	Proj. No.	Description	CWE (FY84\$)	B/C	E/C	Payback Period (Years)	Annual Energy Savings (MBtu)	Annual Dollar Savings (FY84\$)
G-Z.		Bldg Shell Insul. (Walls) Bldg 14	13,486	1.8	6.2	13.0	84	1,034
G-AA.		Bldg Shell Insul. (Walls) Bldg 3500 (Included with G-H write-up)	10,500	1.8	6.0	13.5	63	776
G-BB.		Bldg Shell Insul. (Ceiling) Bldg Nos 1649 & 1650 (Included with G-E write-up)	39,059	1.7	5.9	13.7	232	2,856
SUBTOTAL A/B:			8,998,166				162,234	1,328,519
SUBTOTAL G :			3,192,454				34,572	340,513
TOTALS:			12,190,620				196,806	1,669,032

TABLE 3-4

Original 2/82
Revised 11/85
Revised 5/86FORT DEVENS - INCREMENTS A & B
NON-QUALIFYING PROJECTS: **

Inc- rmt./	Proj. No.	Description	CWE (\$)*	B/C	E/C	Payback Period (Years)	Annual Energy Savings (MBtu)	Annual Dollar Savings (\$)*
A/B-O.		Installation of Electric Ignition Devices & Vent Dampers on Family Housing Gas-Fired Water Heaters	700,584	1.8	12.9	9.3	9,069	75,012
A/B-M.		General Warehouse (Bldg 1400) Lighting Mods (FY 84)	145,230	2.82	12.6	5.0	1,823	28,818
A/B-N.		Window Replacement in EM Barracks (637 and 638) (FY 84)	118,911	2.66	12.3	8.9	1,463	13,299
A/B-W.		Insulation of Walls and Roof of General Warehouse 1400 (FY 84)	235,900	--	11.9	--	2,809	---
A/B-P.		Insulation of Walls in EM Barracks (666, 673, 674, 693, 695, 697, 658, 647, 648, 651, 652, and 655)	735,172	1.9	10.4	12.1	7,663	60,612
A/B-Q.		Family Housing Kitchen & Bathroom Lighting Renova.	645,843	1.3	9.9	13.2	6,382	48,938
A/B-V.		Installation of Boiler Economizers in Bldgs 649, 650, 657, 665, 694 & 696	403,200	1.8	9.4	13.4	3,794	30,010
A/B-R.		Solar Heating of Swimming Pool	213,920	---	8.7	15.5	1,856	13,779
A/B-S.		Solar Domestic Hot Water for Wherry Housing	238,507	---	4.7	26.0	1,114	9,128
A/B-T.		Insulation of Swimming Pool Enclosure (Bldg 621)	379,331	0.9	3.8	32.0	1,449	11,853
A/B-U.		Installation of Ceiling Fans in High Ceiling Bldgs	--	---	---	---	---	---

* Unless otherwise noted in description column, costs in FY83\$.

** Many of these projects later qualified under Increment G.

TABLE 3-4 (Cont'd.)

Original 2/82
Revised 11/85
Revised 5/86FORT DEVENS - INCREMENT G
NON-QUALIFYING PROJECTS:

Inc- rmt.	Proj. No.	Description	CWE (FY83\$)	B/C	E/C	Payback Period (Years)	Annual Energy Savings (MBtu)	Annual Dollar Savings (FY83\$)
G-CC.		Install. of Electric Ignition Devices & Vent Dampers on Family Housing Gas Fired Water Heaters	923,143	1.0	9.3	11.0	9,069	90,113
G-DD		Steam Line Insul Bldg. Nos 649, 57 665, and 696	4,340	1.0	7.5	14.6	33	296
G-CCC		Bldg Shell Insulation (Ceiling) - (Included with G-II write-up)	9,292	1.5	6.9	16	63.9	581
G-QQ		Bldg Shell Insul (Walls) - Bldg No.25 (Headquarters Annex) (Included in G-LL write-up)	38,076	1.9	6.5	15.6	249	2,440
G-RR		Bldg Shell Insul (Walls) - Bldg Nos. 649,650,657,665,694 & 696 (Consolidated Mess) (Included in G-II write-up)	41,828	1.3	5.9	19	245	2,227
G-SS		Bldg Shell Insul Bldg No.624	21,311	1.5	5.3	15.3	111	---
G-EE		Bldg Shell Insul (Walls) Bldg 3586	13,090	1.5	5.2	19.6	68	669
G-TT		Bldg Shell Insul (Walls) Bldg 3712 (Commissary Warehouse) (Included in G-NN write-up)	64,776	1.1	5.1	22	330	3,000
G-UU		Bldg. Shell Insul (Ceiling) - Bldg i434 (ASA Warehouse) (Included in G-PP write-up)	Vault & Warehouse Combined: 5.0					
			Vault: 5,297	1.4	4.8	16.8	25.6	---
			Warehouse: 14,478	1.5	5.1	15.9	74	---
G-VV		Bldg Shell Insul (Walls) - Bldgs 683 & 685 (Small Chapels) (Included in G-ZZ write-up)	Sanctuary & Office Combined: 4.9					
			Sanctuary: 19,212	1.5	5.0	16.3	96	---
			Office: 10,157	1.4	4.7	17.2	48	---

TABLE 3-4 (Cont'd.)

FORT DEVENS - INCREMENT G
NON-QUALIFYING PROJECTS

Inc- rmt./	Proj. No.	Description	CWE (FY83\$)	B/C	E/C	Payback Period (Years)	Annual Energy Savings (MBtu)	Annual Dollar Savings (FY83\$)
G-FF.		Bldg Shell Insul. (Ceiling) Bldg 3586 (Included with G-EE write-up)	11,798	1.3	4.4	23.4	51	504
G-WW.		Bldg Shell Insul. (Walls)-Bldg 17 REF	61,988	0.8	3.6	31	223	---
G-GG.		Bldg Shell Insul. (Ceiling) Bldg 14 (Included with G-Z write-up)	25,500	1.0	3.5	22.8	89	1,096
G-XX.		Bldg Shell Insul. Bldg No. 3773 (USA Reserve Center)	36,697	1.0	3.4	30	126	1,235
G-HH.		Bldg Shell Insul. (Ceiling) Bldg 1 (Included with G-R write-up)	17,369	0.8	2.7	38.5	46	451
G-YY.		Bldg Shell Insul. (Walls) Bldg 17-Chapel (Included with G-00 write-up)	33,412	0.6	2.7	40	91	---
G-ZZ.		Bldg Shell Insul (Ceiling) Bldg Nos. 683/685 (Small Chapels) (Included with G-VV write-up)	32,128	0.8	2.7	30	86	---
G-AAA.		Bldg Shell Insul. (Ceiling) Bldg 17-Chapel (Included w/G-00 write-up)	41,336	0.3	1.2	93	49	---
G-BBB		Ceiling Fans Bldg Nos. 692, 3712, 17, 1693, 2730, & 3757	---	---	---	∞	---	---

Preliminary calculations for option (a.) showed that increased labor costs, additional electricity use, and repair parts decreased annual savings such that further study was not warranted. The following summarizes the results of this study for option (b.):

Construction cost \$1,999,052	B/C 3.00
Annual energy savings 47,603 MBtu	E/C 23.8
Annual cost savings \$21,744	Payback 91.9 years

5. Increment G: Projects Identified in Increments A & B That Do Not Meet ECIP Criteria

Identification of Increment G projects were accomplished during Phase I and II of Increments A and B. These projects are energy saving projects that do not qualify under ECIP criteria. There were 55 projects developed in this increment; 19 were recommended for funding.

The recommended projects represent an investment of \$3,192,454 with an estimated annual savings of 34,572 MBtu and \$340,513.

Projects investigated under Increments A, B & G's scope of work are summarized in Tables 3-3 and 3-4. Projects are prioritized by their E/C ratio and grouped into the two categories of qualifying/recommended and non-qualifying/not recommended. Qualified projects (Table 3-3) under Increments A & B are those which have a 1982 E/C > 15, (a 1983 E/C > 14 or a 1984 E/C > 13) have a B/C greater than one and have a construction cost in excess of \$100,000 (1983). Qualifying projects under Increment G are those which have a simple payback less than 15 years and have a B/C greater than one. Non-qualifying projects (Table 3-4) are those which do not meet the standards for qualifying projects. Many of these A/B projects later qualified under Increment G and are contained in Table 3-3. Complete descriptions, calculations and back-up information can be found in the previously completed Increments A/B and G Reports. Each project has a two-part identifier which is composed of the increment designation. For example, A/B-D means Project D studied during Increment A/B.

6. Increment E: Central Coal-Fired Heating Plants

Increment E for Fort Devens determines the practicability and economic feasibility of either converting existing petroleum fueled units to solid fuel firing or constructing a solid fuel-fired central boiler plant (s) to supply steam or high temperature water to all or discrete parts of the Fort Devens complex. The solid fuels considered were coal, solid waste (RDF) and wood. Several system configurations are examined and compared to maintain and operate existing heating systems.

The results of the study indicate that the future energy needs of Fort Devens can be met most economically by continuing with the existing natural gas and oil-fired heating units. However, due to a small difference in the total life cycle costs between the coal-fired plant designated as the West Plant and its counterpart (existing petroleum-fired units), and program emphasis on reducing the Army's dependence on foreign oil, it is recommended that the new coal-fired West Plant be constructed. The Commonwealth of Massachusetts, Division of Air Quality Control, Department of Environmental Quality Engineering was contacted regarding air pollution regulations for the subject Project. Baghouses, plus low-sulphur, low ash coal are recommended to meet emission requirements.

The economic analysis for this increment was done on a present worth basis. The following is a summary of these results (FY83 \$).

<u>Present worth comparisons</u>		
	<u>Base Case (existing)</u>	<u>Coal Plant</u>
Construction cost	-	\$14,358,600
Maintenance	\$ 5,283,515	7,522,303
Fuel	\$21,577,121	6,462,154
Totals	\$26,860,636	\$28,343,057

7. Energy Audits of Cutler Army Community Hospital and
Associated Facilities

The buildings covered in this phase include the Cutler Army Hospital (#3654), the Vail Dental Clinic (#2729) and the Oral Health Center (#2283).

The energy audits consisted of a field survey, analysis of energy conservation opportunities and development of 1391's and other programming documents for qualifying projects. The meter plan option was not included as part of this contract. As a result of this study, several energy saving projects were recommended for funding. These are shown below.

Cutler Army Hospital

Two projects have been recommended for the Cutler Army Hospital. One, an OMA QRIP project, is "Replacement of Roll-Up Door Threshold Weatherstripping" in the vehicle storage area. The cost of this project is only \$464 with a SIR equal to 2.98 and a payback of 1.75 years. The other is an ECIP - "HVAC Modifications". This project includes the following:

- Reduction of supply air volume
- Reduction of outside air volume
- AHU economizers
- Run around loop heat recovery
- High efficiency electric centrifugal chiller
- Boiler economizer
- High efficiency motors
- Day/night setback local controller

Table 3-5 lists projects by SIR.

TABLE 3-5 PROJECT GROUPING PRIORITIZED BY SIR - HOSPITAL

PROJECTS	TYPE	Current Construction Cost (1000's)	Annual Energy Savings (MBtu)	Annual Fuel Cost Savings (1000's)	SIR
THRESHOLD WEATHERSTRIPPING	OMA QRIP	\$0.46	48	\$0.267	2.98
HVAC MODIFICATION	ECIP	\$1009.00	19,371	\$126.80	1.66
TOTAL		\$1009.46	19,419	\$127.10	

Associated Facilities

Seven individual ECO's for the Associated Facilities were found to have SIR's greater than one. These were grouped into two qualifying projects described in Table 3-6. One combined project is to be submitted as a QRIP and the other to be submitted as a PECIP. The two combined projects will provide a yearly energy savings of 1,754 MBtu. First year savings total \$9,163. Construction cost for the QRIP is \$3,738. Construction cost for the PECIP project is \$17,080. It is expected that the QRIP project will be implemented in 1986 and the PECIP project will be implemented in 1987.

TABLE 3-6 PROJECT GROUPING PRIORITIZED BY SIR - ASSOCIATED FACILITIES

PROJECT DESCRIPTION		SIR
QRIP FOR ASSOCIATED FACILITIES		5.14
Furnance baffles - OHC		
Reduce lighting - VDC		
Elec motor control - VDC		
Total energy saved	437 MBtu/yr	
Total construction cost	\$3,738	
Non-energy savings (costs)	\$1,606 per yr	
Simple payback period*	1.27 years	
PECIP FOR ASSOCIATED FACILITIES		3.71
Rep water heater - OHC		
Night setback - VDC		
Night setback - OHC		
Ceiling insulation - OHC		
Total energy saved	1,259 MBtu	
Total construction cost	\$17,080	
Non-energy savings (costs)	(\$ 59 per yr)	
Simple payback period*	2.98 years	

* Simple payback is taken from ECIP Life Cycle Cost Analysis Summary forms. It is defined there as Total Investment divided by first year savings.

8. Increment F - Facilities Engineer Conservation Measures

This phase of work provided for: (A) The development of recommendations for modifications and changes in the system operation which are written within the Facilities Engineer Funding Authority and Management Control, (B) The development of a prioritized summary of these energy conservation measures and projects, (C) The identification of energy related areas where Facilities Engineering personnel training is required, and (D) The listing of energy related proposed changes in Fort Deven's Master Plan.

Nine modifications/changes in system operation were investigated and the results of these investigations are shown below in Table 3-7, taken from the Narrative Report called Project Summary, Increment F. Projects are prioritized by their SIR and grouped into the two categories of qualifying and non-qualifying. Qualifying projects are those which have a SIR greater than 1.0 and are within the DEH's funding authority. Non-qualifying projects have a SIR less than 1.0 and/or exceed the DEH's funding authority. The SIR is based on a life which does not exceed the proposed equipment life, the facility's life, or 25 years, whichever is least. Four courses for energy-related training were identified and are discussed in detail in Section 4.0 of the Narrative Report, Training Opportunities. Information included are course type, cost and duration.

TABLE 3-7

FORT WENS
PROJECT SUMMARY - INCREMENT F

ANNUAL ENERGY SAVINGS (MBTU)

Project ID	Project Description	Current Construction Cost (\$84\$)	SIR	Payback Period (Yrs)	Fuel Oil	Natural Gas	Elec.	Total	Material Cost (\$84\$)	Annual Dollar Savings (\$84\$)	Man-hours
<u>Qualifying/Recommended Projects</u>											
F-H1	Expand EMCS	\$ 19,560	19.08	0.75	2,049	2,508	-	4,557	\$ 13,468	\$ 28,390	168
F-D	Exhaust Fan Covers, Bar-racks 667-670	29,570	1.91	6.30	634	-	-	634	19,027	4,708	96
F-E	Roll-Up Doors Replacement, Bldg. 3500	9,177	1.77	7.82	-	167	-	167	8,738	1,177	12
SUBTOTALS		\$ 58,307	-	-	2,683	2,675	-	5,358	\$ 41,233	\$ 34,275	276
<u>Non-Qualifying/Not Recommended Projects</u>											
F-H2(3)	Expand EMCS with Local Controller	\$ 30,948	11.81	1.23	2,049	2,508	-	4,557	\$ 21,091	\$ 28,390	272
F-A(2)	Pipe Ins./Bldg 243	445	7.96	2.20	31	-	9	40	114	203	9
F-C(4)	Temperature Set-back Controls	667,944	2.44	4.99	19,349	2,607	-	21,968	503,202	127,842	4,484
F-B(4)	Barracks Fancoils	1,563,927	2.13	5.90	51,884	125	-11,622	40,387	1,013,944	237,629	11,034
F-F	Water Heater Heat Pumps, Family Housing(1)	1,125	0.72	15.20	-	22	-24	-2	940	74	5
F-G	Strip Door Curtains	23,581	0.37	11.14	286	-	-	286	15,464	2,124	222

Original 11/85
Revised 5/86

(1) Calculations performed on a per-unit basis.

(2) Not recommended because of building heating system's being replaced.

(3) Project F-H2 is merely a different way to accomplish energy savings than F-H1. Since F-H1 has a high SIR, F-H2 is rejected.

(4) F-B and F-C are good projects with high SIR's, but do not fall within the DEH funding limit of \$50,000 for alteration work.

8.1 Energy Conservation Measures Accomplished Since 1975

Many energy conservation measures were accomplished by the installation since 1975. They are shown below in Table 3-8 with their corresponding completion dates. Table 3-9 contains energy conservation projects that have been planned by Fort Devens.

TABLE 3-8
FORT DEVENS
ENERGY CONSERVATION MEASURES
ACCOMPLISHED SINCE 1975

PROJECT TYPE	PROJECT DESCRIPTION	COMPLETION DATE
ECIP	Kitchen Exhaust Heat Recovery, 4 Mess halls	83, 86
ECIP (FH)	Installation of Storm Windows, 1100 Qtrs	82
	Installation of Attic Insulation, 112 Qtrs	82
	Installation of Storm Doors, 100 Qtrs	82
	Installation of Floor Insulation, 111 Qtrs	82
	Thermostat Radiator Valves, 178 Qtrs	82
	Fireplace Screening, 33 Colonial Qtrs	82
	Reroof & Insulation, 45 Qtrs	82
	Wherry Housing Wall Insulation	84
	Replace of NAG Furnaces	85
QRIP	Barracks Lighting Replacement	84
Other	Replace Kitchen Fans Var FH Units	83
	Replace Attic Fans FH Areas	83
	Replace Burners & Boiler Feed System 3713	83

TABLE 3-8 (Cont'd.)

FORT DEVENS
ENERGY CONSERVATION MEASURES
ACCOMPLISHED SINCE 1975

PROJECT TYPE	PROJECT DESCRIPTION	COMPLETION DATE
Other Cont'd.	Replace Chiller at O Club	83
	Rehab. Overhead Elect. Dist. System	83
	Furnish/Install Warm Air Furnaces in Bldgs 239, 3619, 3546, 2735, 1653 and (2) Units 234	82
	Replace Air Conditioning Units 1696	82
	Furnish & Install Floodlights Heritage Square	82
	Upgrade Lights - Bldg. T-218 & 222	83
	Replace Burners 649, 650 & 657	82
	Replace Ceiling Insulation 226	82
	Reroof 23 FH Units	82
	Replace Boiler 620 (P&C Signed Off)	82
	Reroof 282 Buildings	82
	Reroof Bldg 2674	82
	Rehab. Commissary Roof & Ramp	82
	Renovate Mess Hall 2458	82
	Replace Steam & Condensate Lines 1414	82
	Repair Brick Chimneys 223, 1425, & 3713	81
	Install Vehicle Exhaust 202	82
	Renovate Cold Storage - Bldg. 226	82
	Bal. Heat in Perm. Bks. 658, 666, 673, 674 & 695	82
	Reroof P1, P2, P10	82
	Replace Boiler P-25	81
	Reroof Building 216	81
	Replacement of Single Glazed Windows LTC Ranches	81
	Replace Roofing - Bldg. 22	80

TABLE 3-8 (Cont'd.)

FORT DEVENS
 ENERGY CONSERVATION MEASURES
 ACCOMPLISHED SINCE 1975

PROJECT TYPE	PROJECT DESCRIPTION	COMPLETION DATE
Other, Cont'd.	Insulate Hot Water Pipes 25 FH Units	81
	Install Vehicle Exhaust - 8 Bldgs	81
	Replace Roof, Greylock Gym	81
	Replace Roofing - Bldg. 17	80
	Install Vehicle Exhaust System & Relocate Steam Cleaner - Bldg. 3713	80
	Reroof Bldgs. 1621 & 1622	80
	Replacement of Windows in 20 Multiple Units	80
	Replace Heat in Two Bays 646	80
	Replace Hot Water Heaters 200 FH Units	80
	Boiler Retubing, Bldg. 649, Fort Devens	80
	Replace Three Door Units - Bldg. 1693	80
	Replace and Svc Doors - Bldg. 16	80
	Heating System Replacement 3701	80
	Construct of Waste Oil Storage Facilities	79
	Install Warm Air Furnace - Bldg. 622	79
	Repair Insulation Two Boilers - Bldg. 657	79
	Insulation, Child Care Center	79
	Boiler Insulation - Bldg. 637	80
	Reroof Buildings 16 & 3816	80
	Replace Heating System, P-6	80
	Replace Doors, #9 & #20 - Bldg. 1400	79
	Replacement of Domestic Hot Water Main - Bldg. 652	79
	Install Vinyl Siding 19 Bldgs	79
	Install Aluminum Windows - Bldgs 3701, 3595 & 3597	79

TABLE 3-8 (Cont'd.)

FORT DEVENS
ENERGY CONSERVATION MEASURES
ACCOMPLISHED SINCE 1975

PROJECT TYPE	PROJECT DESCRIPTION	COMPLETION DATE
Other, Cont'd.	Hot Water Piping and Insulation - Bldg 1011	79
	Repair Evaporator, Condensor and Compressor - Bldg 226	79
	Reroof Bldgs 646, 653 & 3654	79
	Reroof Bldgs 6, 8, 25 & 227	77
	Replace Boiler 3818	77
	Replace Roof - Bldg T-2007	78
	Install Aluminum Windows & Doors, 4 Bldgs	78
	Install Vinyl Siding - Bldg 225	78
	Reroof 10 FH Units	78
	Repair/Replace Casement Windows FH	78
	Repair/Replace Built-Up Roofing	78
	Insulate - Bldg. 3701	78
	Install Exhaust Fans - Bldg. 649	78
	Replace Lighting 3712	77
	Reroof - Bldgs 312, 313 & 314, Fort Devens	77
	Replace Deteriorated Lighting T-216	77
	Replacement of Windows & Door - Bldg. 227	77
	Replace Boiler, P-3, Fort Devens	77
	Reroof 32 Sets FH Quarters	76
	Reroof 11 Bldgs, Fort Devens	76
	Vinyl Siding - Bldgs 2806, 2688 & 227	76
	Replace Heating Coils 689	76
	Reroof 55 FH Bldgs	76
	Install Comb. Aluminum Doors FH	77
	Reroof - Bldg 643, Fort Devens	77

TABLE 3-8 (Cont'd.)FORT DEVENS
ENERGY CONSERVATION MEASURES
ACCOMPLISHED SINCE 1975

PROJECT TYPE	PROJECT DESCRIPTION	COMPLETION DATE
Other, Cont'd.	Reroof - Bldg 202	75
	Reroof 25 Roofs - Various Bldgs, Ft. Devens	75
	Install Heat Zone Controls - Bldg 243	75
	Reroof - Bldg 11 & 12	75
	Install Exhaust Hood, Cutler Army Hospital	75
	Replace Window Units - Bldg 243	75

TABLE 3-9FORT DEVENSPLANNED ENERGY CONSERVATION MEASURES

PROJECT TYPE	PROJECT DESCRIPTION	PROJECTED COMPLETION
ECIP	Insulation of Walls and Windows - Bldg. 3713	87
	Street Lighting Modifications, HP Sod	87
	Area and Parking Lighting Modifications	87

8.2 PROPOSED CHANGES IN MASTER PLAN

Conversations with Fort Devens personnel indicated that 107,469 square feet of building space is to be added in FY 85 and 43,000 square feet in FY 86. The increase in Fort Devens energy consumption due to the addition of these facilities can be estimated using the post-wide average energy use for FY 84 on a per square foot basis. In FY 84 energy use in facilities was calculated to be 173 MBtu per thousand square feet (Fort Devens Energy Plan). This yields an increased energy use of 18,700 MBtu per year beginning in FY 85 plus an additional 7,439 MBtu per year beginning in FY 86.

8.3 POLICY CHANGES/RECOMMENDATIONS

During the field survey many energy savings opportunities were found in the area of operations and maintenance. Individually they are minor, but collectively represent considerable energy waste.

1. Outdoor lights left on during daylight hours

Problem areas include family housing (especially back door lights), temporary building "fire lights", and motor pool areas.

2. Overheating spaces during winter

Virtually all buildings are heated in excess of the 65°F/68°F Army guidelines. Many, especially those with radiators, are near 80°F. The EM Barracks and bldg. 1401 were particularly overheated.

3. Windows open while heating

The EM Barracks are the primary offenders. This is partially due to the overheating problems. However, windows were also found open in unoccupied rooms.

4. Water heater temperatures in excess of 105°F except for family housing dishwashers, mess hall dish washers and other special requirements

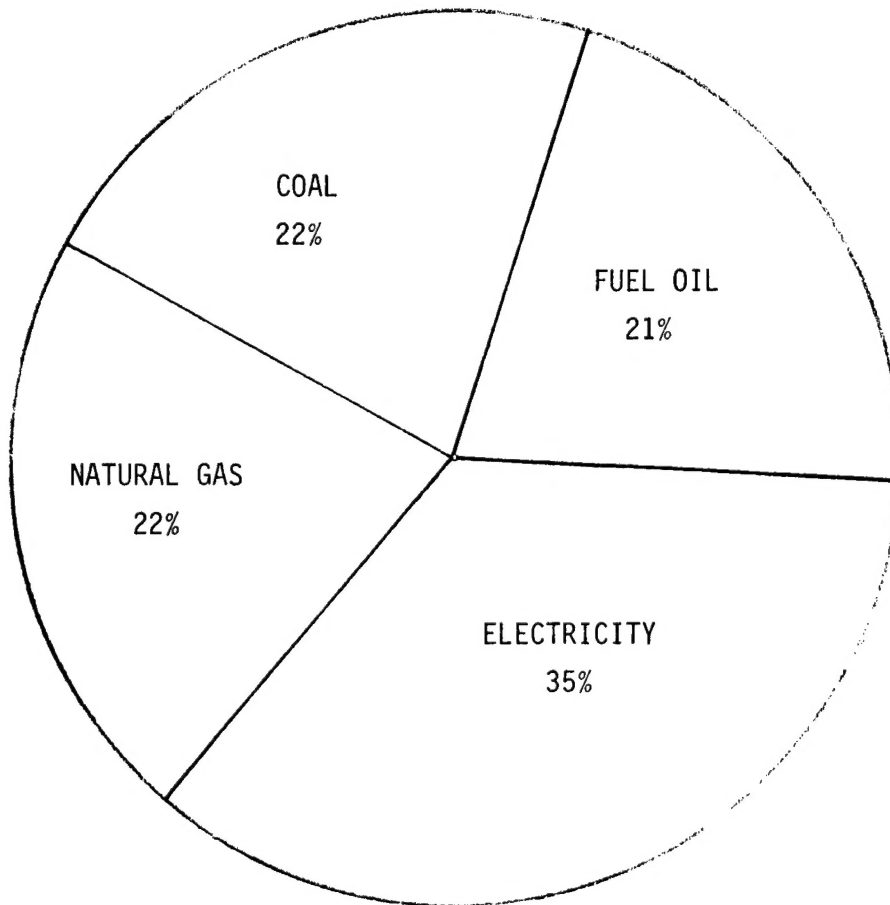
Barracks hot water temperatures vary from 130°F to 160°F. Most of the temporary building barracks had similar readings. Family housing hot water temperatures ranged from 114°F - 152°F. Other offenders measured include bldg. #613, 1434 and 3773.

9.0 SUMMARY OF ENERGY AND COST SAVINGS

Table 3-10 is a summary of the energy savings which will be achieved by implementation of the recommended projects included in Increments A & B, E, F and G and energy audits of the Cutler Army Community Hospital and associated facilities. Figure No. 9 illustrates the total energy use by fuel type after implementation of these projects. Actual energy consumption for FY 85 by fuel type is shown in Table 3-11, with projected consumption for FY 86-88 based on proposed changes in the Master Plan (Section 8.2). The energy costs in Table 3-12 are developed from actual FY 85 costs which were escalated according to industrial sector figures from "Economic Studies for MCP Designs." Figure No. 10 illustrates total energy costs.

TABLE 3-10FORT DEVENS PROJECT SUMMARY

Project Type	<u>E N E R G Y S A V I N G S (MBtu)</u>				
	Coal	Fuel Oil	Natural Gas	Electricity	Total
Incr. A/B	-	109,109	46,842	6,301	162,252
Incr. E	-296,250	245,667	25,659	-6,429	-31,353
Incr. F	-	2,683	2,675	-	5,358
Incr. G	-	23,228	9,995	1,349	34,572
Hospital	-	24,982	-	-5,563	19,419
Assoc. Fac.	-	671	-	1,025	1,696
	-296,250	406,340	85,171	-3,317	191,944



TOTAL ENERGY USE - 1,315 BILLION Btu's

FORT DEVENS
ENERGY USE DISTRIBUTION
AFTER PROJECT IMPLEMENTATION

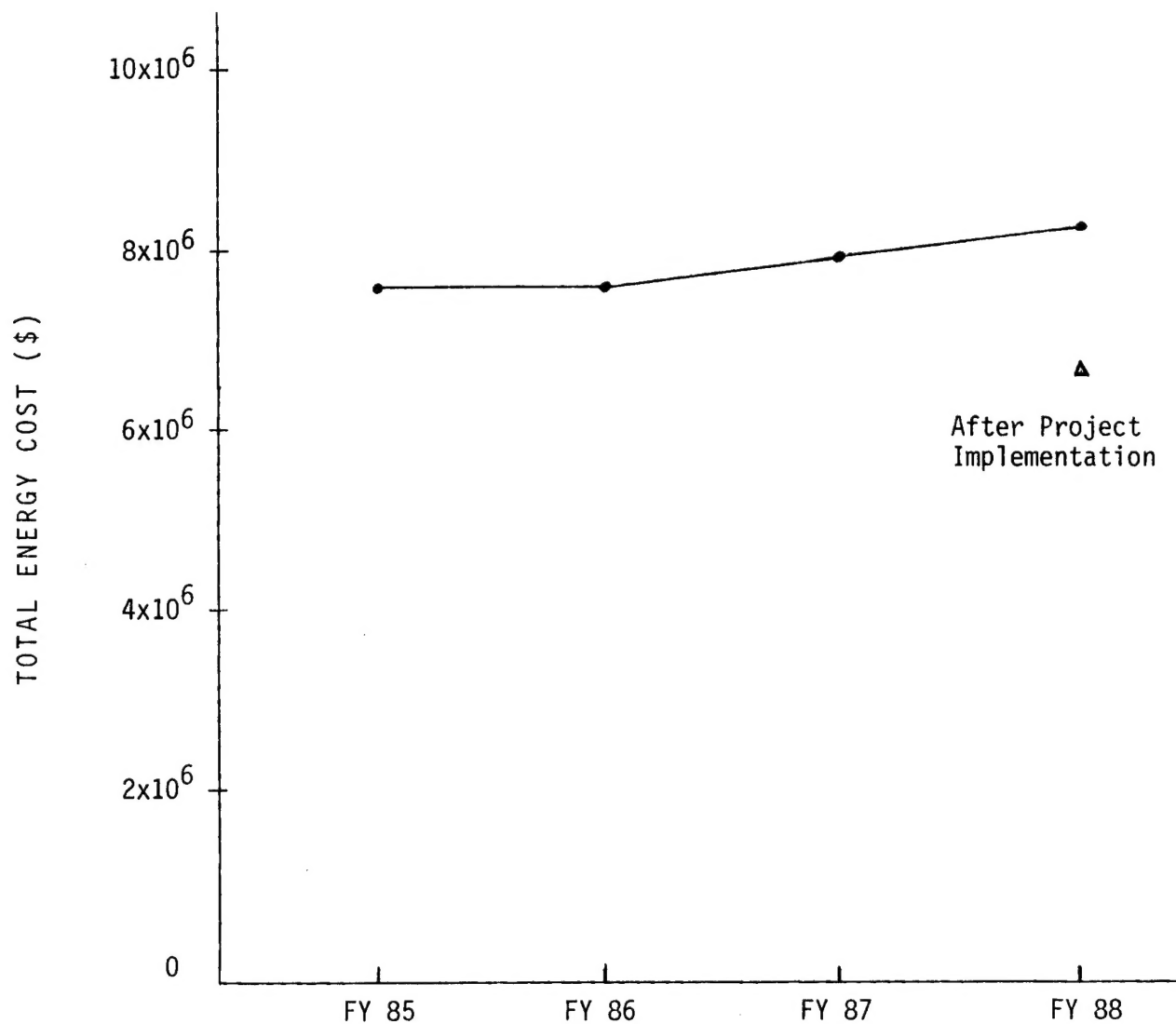
FIGURE NO. 9

TABLE 3-11FORT DEVENSACTUAL AND PROJECTEDENERGY CONSUMPTION

FUEL TYPE	<u>E N E R G Y C O N S U M P T I O N (MBtu)</u>		
	<u>FY 85 (Actual)</u>	<u>FY 86-88 (Projected)</u>	<u>After Projects Are Implemented (Projected)</u>
Fuel Oil	535,420	538,247	271,810
Natural Gas	338,160	339,945	291,579
Electricity	535,420	538,247	455,417
Coal	-0-	-0-	296,250
TOTAL	1,409,000	1,416,439	1,315,056

TABLE 3-12FORT DEVENSACTUAL AND PROJECTEDENERGY COSTS

FUEL TYPE	<u>T O T A L E N E R G Y C O S T (\$)</u>				
	<u>FY 85</u>	<u>FY 86</u>	<u>FY 87</u>	<u>FY 88</u>	<u>FY 88 w/Projects</u>
Fuel Oil	3,480,230	3,455,546	3,471,693	3,573,960	1,804,818
Natural Gas	2,384,028	2,396,612	2,563,185	2,709,362	2,323,885
Electricity	1,804,365	1,830,040	1,905,394	1,996,896	1,689,597
Coal	-	-	-	-	764,325
TOTAL	7,668,623	7,682,198	7,940,272	8,280,218	6,582,625



FORT DEVENS
ACTUAL AND PROJECTED
ENERGY COSTS

FIGURE NO. 10